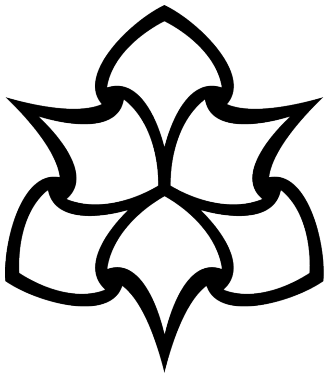

A Sentinel Population: The public health benefits of monitoring enhanced body builders

Abstract

There is heightened recognition of the public health implications of anabolic androgenic steroids (AAS) for the use of image and performance enhancement; with increasing evidence of their long-term negative health impacts, the hazards associated with their administration (often via injection), and the variability and unpredictability of their contents. In order to optimise the effects of these drugs, together with strict dietary and training regimes, AAS users typically supplement their use with an expansive and continually evolving range of ancillary drugs. The discovery and subsequent adoption of these drugs by the broader AAS user population is largely dependent upon a minority of social influencers within the bodybuilding community.

Pioneering enhanced bodybuilders who self-experiment with a diverse range of image and performance enhancing drugs (IPEDs) and ancillary drugs have been the forerunners in the development of an underground user-led literature, online discussion forums, and were early adopters of internet-facilitated drug markets. Yet the impact of their self-experimentations extends well beyond the enhanced bodybuilding community, particularly in their use of ancillary drugs.

Most significantly has been their role in the diffusion of various enhancement and psychoactive drugs to the wider population. Using the theoretical framework of the 'diffusion of innovation' we consider the role that pioneering enhanced bodybuilders have played in the diffusion of various enhancement and psychoactive drugs to the wider population through a focus on three substances –dinitrophenol (DNP), melanotan II and gamma-hydroxybtyrate (GHB). With an increasing range of drugs used by bodybuilders, coupled with an expansion in the use of online forums and online platforms to purchase pharmacological and new psychoactive drugs, we anticipate this trend of diffusion amongst the wider population will continue to flourish. Therefore, we highlight the need for policy makers to monitor emergent trends, not only in the general AAS population but particularly amongst enhanced bodybuilders.

A Sentinel Population: The public health benefits of monitoring enhanced body builders

The following commentary reviews the case for and the evidence to support the public health surveillance of AAS users and particularly the pioneering influential innovators within their community whom we term “enhanced bodybuilders”. In a departure from traditional calls to policy makers for the monitoring of AAS users (Hope, McVeigh et al. 2013, Iversen, Topp et al. 2013), we employ the concept of 'diffusion of innovation' in looking beyond the immediate health protection and harm reduction of the users to consider the potential value to the wider drug using populations.

Anabolic androgenic steroids as a public health concern

The use of anabolic androgenic steroids (AAS) is now considered a significant global public health policy issue (Evans-Brown, McVeigh et al. 2012, Kanayama, Kaufman et al. 2018). Prevalence of AAS is difficult to determine, nevertheless global prevalence has been estimated at levels as high as 3.3% (Sagoe, Molde et al. 2014), with other scholars suggesting that approximately 3 million men have used AAS in the United States alone (Pope, Kanayama et al. 2014). Whilst relatively high levels of AAS use have been identified in the United States, Australia and Northern Europe for several decades, usage at high levels has recently been identified in other regions such as South America and the Middle East (Abrahin, Sousa et al. 2014, Zahnow, McVeigh et al. 2017, Sagoe and Pallesen 2018, Hearne, Wazaify et al. 2020). In addition to the estimated numbers of users, recent studies have identified diverse populations of AAS users in relation to both characteristics and motivations for use, ranging from the unplanned, hedonistic user through to the expert enhanced bodybuilder (Christiansen, Vinther et al. 2016, Zahnow, McVeigh et al. 2018).

The major cause for concern regarding AAS is their association with a range of adverse health conditions and associated morbidity and mortality. Summarised in the Endocrine Statement of 2014, AAS are associated with harms to many of the body’s systems including cardiovascular effects, hematologic effects, psychiatric and neuropsychologic effects, and hormonal and metabolic effects (Pope, Wood et al. 2014). As we enter the 2020s, we have increasing data to evidence the long-term effects of AAS use. The potential for cardiac damage highlighted during the 1980s and 1990s (Mochizuki and Richter 1988, Herschman 1990, Hartgens, Kuipers et al. 1996) has been realised in the form of increased case reports (Baggish, Weiner et al. 2017, Doleeb, Kratz et al. 2019) and analyses of post mortem data (Sculthorpe, Grace et al. 2010, Montisci, El Mazloum et al. 2012, Pope, Wood et al. 2014). Additionally, hypogonadism has been identified as a significant health issue for many sustained AAS users (Karavolos, Reynolds et al. 2015), requiring clinical interventions

(Street and Scally 2000, Tan and Vasudevan 2003, Rahnema, Lipshultz et al. 2014). Perhaps the most significant and concerning is the emerging evidence of the adverse effects of long-term AAS use in relation to the brain. Whilst it has long been acknowledged that AAS can result in psychiatric symptoms (Perry, Yates et al. 1990, Pope and Katz 1992, Su, Pagliaro et al. 1993), such symptoms appear to be at least in part dose-dependent (Hall, Hall et al. 2005) and largely idiosyncratic (Pope, Wood et al. 2014). However, recent studies have identified structural changes to the brain (Bjornebekk, Walhovd et al. 2017, Westlye, Kaufmann et al. 2017) with associated cognitive impairment (Bjornebekk, Westlye et al. 2019, Hauger, Westlye et al. 2019).

The adverse effects of AAS alone provides a compelling case for policy makers to develop public health surveillance of this population, in order to protect and promote their health and well-being. Further evidence to support the monitoring and surveillance can be found in the findings from research in the United Kingdom related to blood borne viruses. Prevalence of HIV and hepatitis C are considerably higher amongst AAS users than that found in the general population (Hope, McVeigh et al. 2013, Hope and Iversen 2019), with HIV levels shown to be on a par with those injecting heroin (Hope, Harris et al. 2016). While the route of transmission, via sex or injecting behaviours together with the timing of infection (potentially prior to AAS use) remains uncertain (Underwood 2019), and sharing of injecting equipment rare when compared to people who inject psychoactive drugs (Van Beek 2015), the fact remains that there are significant numbers of HIV positive men amongst some populations of AAS users and this is a public health concern (Iversen, Topp et al. 2013, Iversen, Hope et al. 2016, McVeigh, Kimergard et al. 2016, McVeigh 2019). Further evidence indicates low levels of users' knowledge related to positive hepatitis C status (Hope, McVeigh et al. 2017) and low uptake of blood borne virus testing amongst AAS injectors (Rowe, Berger et al. 2017, Hope and Iversen 2019) with the exception of gay and bisexual men. In the main, AAS using populations consist largely of men, with high levels of sexual activity and low condom use, regardless of sexual orientation (Ip, Yadao et al. 2017, Hope and Iversen 2019, Ip, Doroudgar et al. 2019). Furthermore, AAS results in an increase in libido for many (Begley, McVeigh et al. 2017, Kees 2019, Pereira, Moyses et al. 2019) and for others the use of drugs such as PDE5i to treat erectile dysfunction (Llewellyn 2017), potentially compounding sexual risk behaviours and warranting public health monitoring.

Further evidence supporting the monitoring of the AAS user population stems from their high levels of polypharmacy (Sagoe, McVeigh et al. 2015, Salinas, Floodgate et al. 2019), both in the pursuit of muscular enhancement and concomitant psychoactive drug use, particularly cocaine (Dodge and Hoagland 2011, Hope, McVeigh et al. 2013, Salinas, Floodgate et al. 2019). A recent study in Norway reported that 28% of patients being treated for substance

use disorders had used AAS (Havnes, Jorstad et al. 2020), levels that are considerably higher than previous research in the United States (Kanayama, Cohane et al. 2003). Yet AAS use is often poorly recognised and inadequately addressed within treatment settings (Havnes and Skogheim 2019) with AAS users at times using these drugs as self-directed treatment for the adverse effects of opiate dependence (Havnes, Jorstad et al. 2020). This polypharmacy clearly requires ongoing investigation.

This growing body of evidence indicates a need for policy makers to establish robust monitoring of this population, to systematically identify and monitor harms experienced by users, and to facilitate the evaluation of interventions. These diverse interventions may aim to prevent or delay initiation into AAS use, mitigate or reduce the harms of use, support the treatment, cessation and relapse prevention or monitor associated behaviours related to sex or psychoactive use. Further still, a case for surveillance may be made because of the potential harms posed to others in the forms of psychopharmacological crime and market crimes (Goldstein 1985) but these arguments sit beyond the scope of this commentary.

The bigger picture: Enhanced bodybuilders, innovation and diffusion

Beyond the evidence of the need to monitor the effects of AAS use on the individual or the wider community, we argue here that there is evidence to support the monitoring of the pioneering enhanced bodybuilders who exert influence on the wider communities of AAS users. It is these innovators that may be considered a “sentinel population”, a group of highly influential individuals who may act as an “early warning system” related to emerging drug practices. Everett Rogers’ work on the diffusion of innovations (Rogers 1983, Rogers 1995) provides a framework with which to understand how certain drug using practices of enhanced bodybuilders may be disseminated largely via the internet beyond the bodybuilding culture to the general population. While by no means a new theory (De Tarde 1903), diffusion theory has evolved over time having been influenced by research into mass communication in the 1950s (Katz, Lazersfeld et al. 2017). The model explains how a “trickle down” effect accelerates, as knowledge, attitudes and behaviours are passed from a small group of innovators, to a larger group of early adopters to the (early and late) majority and finally the “laggards” (Rogers, 1983). In the case of AAS and ancillary drugs, this process manifests itself in the following way: (i) influential pioneering bodybuilders self-experiment with certain novel drugs and then advocate their use via online platforms; (ii) enhanced competitive bodybuilders and certain dedicated gym enthusiasts are “early adopters” of these drugs; (iii) their use gains traction amongst the wider dedicated gym training community (the “early majority”) (iv) before diffusing out amongst the general population (the “late majority” and “laggards”). The theory has been effectively applied to the UK’s

phenomenon of Novel Psychoactive Substances (NPS) (Sumnall, Evans-Brown et al. 2011), within a sophisticated online society (Corazza, Parrott et al. 2017) and appears particularly applicable to the current context in which enhanced bodybuilders can generate a massive online following (Underwood 2017, Underwood and Olson 2018)

Many of the common practices adopted by enhanced bodybuilders can be traced back to the 1980s and early 1990s and the pioneering work of authors such as Dan Duchaine (Duchaine 1982, Duchaine 1989, Duchaine 1996) and Bill Phillips (Phillips 1991). Duchaine's Underground Steroid Handbooks are credited as being the most influential within bodybuilding circles. As well as being infamous with the authorities, criminal justice organisations and policy makers (Berg 2011), he came to the general public's attention in 1988, on the front page of the *New York Times* with the headline: "A guru who spreads the gospel of steroids" (Alfano and Janofsky 1988).

Dinitrophenol (DNP) is a prime example of a drug that can be observed as having been used across multiple diverse settings, including amongst enhanced bodybuilders. The origins of DNP can be traced back to the early 20th century with the identification of adverse effects stemming from its use in the manufacturing of munitions (Barral 1916, Perkins 1919, Evans-Brown, McVeigh et al. 2012). DNP's potential as a weight loss medication were soon realised, but cut short after the drug was banned in the 1930s following the identification of severe adverse effects, including fatalities (Evans-Brown, McVeigh et al. 2012). Dan Duchaine is credited with bringing this powerful weight loss product to the attention of the enhanced bodybuilding community (Baker 1997). However, the subsequent expansion of interest and adoption of DNP as an image and performance enhancing aid has largely been driven by the internet and its promotion through AAS online outlets and its marketing as an effective slimming aid (McVeigh, Germain et al. 2017). These digital mediums helped elevate the use of this metabolic poison from a limited number of enhanced bodybuilders who reported sporadic adverse effects (Grundlingh, Dargan et al. 2011) to fatalities amongst vulnerable and naive sections of the general population, seeking an easy weight loss solution (Kamour, George et al. 2015, Petroczi, Ocampo et al. 2015).

Secondly, it is possible to chart similar instances of diffusion by examining the growth of melanotan II, a relatively new drug with properties that mimic the effects of exposure to the sun, whilst also reportedly inducing penile erections and increasing sexual desire and weight loss (Hadley and Dorr 2006). While much of the concerns regarding melanotan II has centred around its injection by naïve users (Van Hout and McVeigh 2019), even with the development and promotion of a nasal formulation, there remains evidence of adverse consequences, such as renal infarction and systemic toxicity (Peters, Hadimeri et al. 2020)

(Nelson, Bryant et al. 2013) and most commonly changes to the skin such as the development of melanoma (Paurobally, Jason et al. 2011, Hjuler and Lorentzen 2014). Competitive bodybuilders who sought all-over tans to help enhance the aesthetic of their muscular definitions were early adopters of this drug, yet its use rapidly filtered down to other AAS users and was observed among service users of needle and syringe programmes in the United Kingdom (Evans-Brown, Dawson et al. 2009). Though melanotan II's diffusion from the enhanced bodybuilding population to a wider "injecting naïve" population was predictable, responses were slow and inadequate (Van Hout and McVeigh 2019).

Thirdly, gamma-hydroxybutyrate (GHB) is an example of a substance again promoted by Duchaine (Assael 2007) and subsequently adopted by different populations within diverse settings, for different intended purposes. First developed in the 1960s for use as an anaesthetic, its use as an image and performance enhancing aid was popularised by Duchaine in the 1980s who used GHB to promote the release of growth hormone and thus enhance muscularity.

The rationale behind the adoption of GHB was its ability to induce deep, prolonged, slow-wave sleep, which was essential in the body's production of growth hormone (Mamelak, Escriu et al. 1977). Whilst adverse effects and issues of dependence were reported amongst enhanced bodybuilders (Hart 2001) the drug gained popularity with a much wider audience in the nightclub scene (McCambridge, Mitcheson et al. 2005), where the drug was sometimes referred to as "G" or "Liquid Ecstasy". Use of the drug continued unabated despite a number of deaths due to overdose and dependence with potentially severe withdrawal symptoms (Busardo and Jones 2015). GHB has been identified as one of the main drugs used by men who have sex with men in the "chemsex" scene (Bourne, Reid et al. 2015, Giorgetti, Tagliabracci et al. 2017). GHB is also associated with drug facilitated sexual assaults (ACMD 2007, Olszewski 2008), and while the true extent of the role of GHB in these cases has been questioned (Beynon, McVeigh et al. 2008, Nemeth, Kun et al. 2010), high profile cases of serial sexual assault and murders have brought renewed attention to the drug (BBC News 2016, Saud 2020).

Here, we have illustrated how enhanced body builders are a sentinel population that should be monitored, with the three case studies highlighting the strong likelihood of future cases occurring. The early identification of diffusion would support effective interventions, perhaps averting some the harms that have occurred in the cases of dinitrophenol (DNP), and gamma-hydroxybutyrate (GHB). With hindsight the diffusion of many drug using practices appears predictable and perhaps even inevitable. Yet there are many other drugs that have not seen this pattern of diffusion, despite having the potential to appeal to a much wider

population than simply enhanced bodybuilders. Drugs such as clenbuterol, a β_2-agonist, has been popular amongst AAS users since the 1980s (Duchaine 1989, Phillips 1991, Llewellyn 2017). The drug is associated with both weight loss and muscular gains, but without the adverse effects of hormonal imbalance that are experienced with AAS. While occasional media reports highlight its appeal to those looking to lose weight – with headlines such as *"Clenbuterol: The new weight-loss wonder drug gripping Planet Zero"(Guest 2007)* – its use is far from widespread and reports of adverse effects of those using outside the enhanced bodybuilding community are rare. Similarly, human chorionic gonadotrophin (hCG) has long been a key element of AAS user's "stack" of drugs (Duchaine 1989, Phillips 1991, Llewellyn 2017). With properties that stimulate the production of testosterone, it has also been promoted as a weight loss product to a wider audience. Such promotion has occurred online https://hcgchica.com/buy-hcg-injections-worldwide/ (accessed 1st April 2020) and within "infomercials" that extoll its properties of rapid weight loss, reduction of cellulite, sleep promotion https://www.fox17online.com/2018/02/06/lose-weight-with-hcg-injections-from-skin-envy (accessed 1st April 2020). However, once again, this drug failed to gain a footing beyond the enhanced bodybuilding community. Why clenbuterol or hCG have not diffused to the wider general population, or if they will in the future, is unclear but without the systematic monitoring of online forums and marketplaces and engagement with the enhanced bodybuilding communities, it is likely that diffusion would result in harms to the wider populations before public health responses could be mobilised.

While anabolic androgenic steroids and human growth hormone remain the mainstay of enhanced bodybuilding, new drugs are constantly added to the repertoire of enhancement products. Some drugs become a fixture within their pharmacopeia, whilst the popularity of other drugs is often short lived. For example nalbuphine – an opioid promoted by "the steroid guru" Dan Duchaine – became popular in the 1990s and resulted in dependence amongst some AAS users, yet fell out of fashion over ensuing years (Cohen, Collins et al. 2007, Begley, McVeigh et al. 2017) without diffusing to wider society. Many of the pharmaceuticals that are experimented with and described by enhanced bodybuilders have the potential for capturing the imagination and gaining a foothold within the general population. A substance such as Cardarine (GW501516), with clinical application in the treatment of diabetes and cardiovascular disease, rapidly gained a reputation amongst enhanced bodybuilders for weight loss with very few side effects. Provided that the drug's marketers can gloss over the fact that clinical research was discontinued due to its cancer-causing properties, the drug is a prime candidate for diffusion to the general population (Mitchell and Bishop-Bailey 2019). Similarly, selective androgen receptor modulators (SARMs) promised a highly anabolic return for less harm, when compared to anabolic steroids (Basaria, Collins et al. 2013,

Narayanan, Ponnusamy et al. 2017) and although not entirely without risk of adverse effects (Flores, Chitturi et al. 2020), these drugs may diffuse beyond the enhanced bodybuilder to a much wider image-conscious population.

The products and practices of enhanced bodybuilders are varied and fluid. Clearly, high profile exponents have a significant influence within the bodybuilders culture and beyond, amongst a wider population of human enhancement drug users and potential users. In monitoring these "innovators" and "early adopters" (Rogers 1983, Rogers 1995) we may gain an early warning of the potential diffusion of these drug practices to the wider population, thereby enabling the rapid development of drug prevention initiatives, harm reduction interventions and ultimately health promotion. Significant harm could be averted if the next DNP or GHB is anticipated and appropriate responses developed. The trends and practices amongst influential enhanced bodybuilders, the dissemination of their experiences, and the diffusion of these ideas to the wider AAS using communities should be monitored and collated for inclusion in public health activity in the wider population (European Monitoring Centre for Drugs and Drug Addiction 2019, Wish, Billing et al. 2020). Central to an effective monitoring system is the meaningful engagement and communication with these "innovators" and "early adopters" of human enhancement drugs, with the overcoming of barriers and mistrust being a pre-requisite to beneficial collaboration (Underwood 2019). The trends emanating from this population may provide important intelligence to policy makers and public health teams of emerging drug problems in the wider population.

Abrahin, O. S. C., E. C. d. Sousa and A. Santos (2014). "Prevalence of the use of anabolic-androgenic steroids in Brazil: a systematic review." Substance Use & Misuse **49**(9): 1156-1162.

ACMD (2007). Drug Facilitated Sexual Assault. London (UK), The Stationery Office,.

Alfano, P. and M. Janofsky (1988). A guru who spreads the gospel of steroids. New York Times. New York**:** 1.

Assael, S. (2007). Steroid Nation. New York, ESPN Books.

Baggish, A. L., R. B. Weiner, G. Kanayama, J. I. Hudson, M. T. Lu, U. Hoffmann and H. G. Pope, Jr. (2017). "Cardiovascular toxicity of illicit anabolic-androgenic steroid use." Circulation **135**(21): 1991-2002.

Baker, M. (1997). "Dan Duchaine – The Steroid Guru Interview with MESO-Rx." 12th December 1997. Retrieved 1st April 2020, 2020.

Barral, M. B. (1916). "Intoxication par le dinitrophenol." Lyon Med **125**: 276.

Basaria, S., L. Collins, E. L. Dillon, K. Orwoll, T. W. Storer, R. Miciek, J. Ulloor, A. Zhang, R. Eder, H. Zientek, G. Gordon, S. Kazmi, M. Sheffield-Moore and S. Bhasin (2013). "The safety, pharmacokinetics, and effects of LGD-4033, a novel nonsteroidal oral, selective androgen receptor modulator, in healthy young men." J Gerontol A Biol Sci Med Sci **68**(1): 87-95.

BBC News. (2016). "Serial killer Stephen Port jailed for rape drug murders." Retrieved 1st April 2020, 2020, from https://www.bbc.co.uk/news/uk-england-38102454.

Begley, E., J. McVeigh, V. Hope, G. Bates, R. Glass, J. Campbell, C. Tanner, J. Kean, G. Morgan, D. Acreman and J. Smith (2017). Image and Performance Enhancing Drugs: 2016 National Survey Results. Liverpool, Liverpool John Moores University.
Berg, J. (2011). "Anabolics iX: An interview with author William Llewellyn." Muscular Development Retrieved 1st April 2020, 2020, from http://www.musculardevelopment.com/articles/chemical-enhancement/3016--anabolics-ix-an-interview-with-author-william-llewellyn.html#.XpqebMhKg2x.
Beynon, C. M., C. McVeigh, J. McVeigh, C. Leavey and M. A. Bellis (2008). "The involvement of drugs and alcohol in drug-facilitated sexual assault - A systematic review of the evidence." Trauma Violence & Abuse **9**(3): 178-188.
Bjornebekk, A., K. B. Walhovd, M. L. Jorstad, P. Due-Tonnessen, I. R. Hullstein and A. M. Fjell (2017). "Structural Brain Imaging of Long-Term Anabolic-Androgenic Steroid Users and Nonusing Weightlifters." Biol Psychiatry **82**(4): 294-302.
Bjornebekk, A., L. T. Westlye, K. B. Walhovd, M. L. Jorstad, O. O. Sundseth and A. M. Fjell (2019). "Cognitive performance and structural brain correlates in long-term anabolic-androgenic steroid exposed and nonexposed weightlifters." Neuropsychology **33**(4): 547-559.
Bourne, A., D. Reid, F. Hickson, S. Torres-Rueda, P. Steinberg and P. Weatherburn (2015). ""Chemsex" and harm reduction need among gay men in South London." Int J Drug Policy **26**(12): 1171-1176.
Busardo, F. P. and A. W. Jones (2015). "GHB Pharmacology and Toxicology: Acute Intoxication, Concentrations in Blood and Urine in Forensic Cases and Treatment of the Withdrawal Syndrome." Current Neuropharmacology **13**(1): 47-70.
Christiansen, A. V., A. S. Vinther and D. Liokaftos (2016). "Outline of a typology of men's use of anabolic androgenic steroids in fitness and strength training environments." Drugs: Education, Prevention and Policy **24**(3): 295-305.
Cohen, J., R. Collins, J. Darkes and D. Gwartney (2007). "A league of their own: demographics, motivations and patterns of use of 1,955 male adult non-medical anabolic steroid users in the United States." Journal of the International Society of Sports Nutrition **4**.
Corazza, O., A. C. Parrott and Z. Demetrovics (2017). "Novel psychoactive substances: Shedding new lights on the ever-changing drug scenario and the associated health risks." Human Psychopharmacology-Clinical and Experimental **32**(3).
De Tarde, G. (1903). The laws of imitation. New York, H. Holt and Co.
Dodge, T. and M. F. Hoagland (2011). "The use of anabolic androgenic steroids and polypharmacy: A review of the literature." Drug and Alcohol Dependence.
Doleeb, S., A. Kratz, M. Salter and V. Thohan (2019). "Strong muscles, weak heart: testosterone-induced cardiomyopathy." ESC Heart Fail.
Duchaine, D. (1982). Anabolic Steriod Handbook. Santa Monica, CA.
Duchaine, D. (1989). Underground steroid handbook II. Venice (CA):, HLR Technical Books.
Duchaine, D. (1996). Underground Bodyopus: Militant Weight Loss & Recomposition, XIPE Press.
European Monitoring Centre for Drugs and Drug Addiction (2019). EMCDDA operating guidelines for the European Union Early Warning System on new psychoactive substances. Luxembourg., Publications Office of the European Union.
Evans-Brown, M., R. Dawson, M. Chandler and J. McVeigh (2009). "Use of melanotan I and II in the general population." British Medical Journal **338**(Feb).
Evans-Brown, M., J. McVeigh, C. Perkins and M. Bellis (2012). "Human enhancement drugs: the emerging challenges to public health." Liverpool: North West Public Health Observatory.
Flores, J. E., S. Chitturi and S. Walker (2020). "Drug-Induced Liver Injury by Selective Androgenic Receptor Modulators." Hepatol Commun **4**(3): 450-452.
Giorgetti, R., A. Tagliabracci, F. Schifano, S. Zaami, E. Marinelli and F. P. Busardo (2017). "When "Chems" Meet Sex: A Rising Phenomenon Called "ChemSex"." Curr Neuropharmacol **15**(5): 762-770.
Goldstein, P. J. (1985). "The Drugs Violence Nexus - a Tripartite Conceptual-Framework." Journal of Drug Issues **15**(4): 493-506.

Grundlingh, J., P. I. Dargan, M. El-Zanfaly and D. M. Wood (2011). "2,4-dinitrophenol (DNP): a weight loss agent with significant acute toxicity and risk of death." J Med Toxicol **7**(3): 205-212.
Guest, K. (2007). Clenbuterol: The new weight-loss wonder drug gripping Planet Zero. The Independent. London.
Hadley, M. E. and R. T. Dorr (2006). "Melanocortin peptide therapeutics: historical milestones, clinical studies and commercialization." Peptides **27**(4): 921-930.
Hall, R. C. W., R. C. W. Hall and M. J. Chapman (2005). "Psychiatric complications of anabolic steroid abuse." Psychosomatics **46**(4): 285-290.
Hart, M. (2001). Tears on a keyboard, The No Bull Collection magazine.
Hartgens, F., H. Kuipers, J. A. G. Wijnen and H. A. Keizer (1996). "Body composition, cardiovascular risk factors and liver function in long term androgenic-anabolic steroids using bodybuilders three months after drug withdrawal." International Journal of Sports Medicine **17**(6): 429-433.
Hauger, L. E., L. T. Westlye, A. M. Fjell, K. B. Walhovd and A. Bjornebekk (2019). "Structural brain characteristics of anabolic-androgenic steroid dependence in men." Addiction.
Havnes, I. A., M. Jorstad, J. McVeigh, M. Van Hout and A. Bjornebekk (2020). "The anabolic androgenic steroid treatment gap: a national study of substance use disorder treatment." Substance Abuse: Research and Treatment.
Havnes, I. A. and T. T. Skogheim (2019). "Alienation and Lack of Trust." Journal of extreme anthropology **3**(2): 94-115.
Hearne, E., M. Wazaify, M. C. Van Hout, A. Atkinson and J. McVeigh (2020). "Anabolic-Androgenic Steroid Use in the Eastern Mediterranean Region: a Scoping Review of Extant Empirical Literature." International Journal of Mental Health and Addiction.
Herschman, Z. (1990). "Cardiac Effects of anabolic steroids." Amesthesiology **72**(4): 773-774.
Hjuler, K. F. and H. F. Lorentzen (2014). "Melanoma Associated with the Use of Melanotan-II." Dermatology **228**(1): 34-36.
Hope, V. and J. Iversen (2019). Infections and risk among people who use image and performance enhancing drugs. Humam enhancement drugs. K. Van de Ven, K. Mulrooney and J. McVeigh. Abingdon, Oxon, Routledge.
Hope, V. D., R. Harris, J. McVeigh, K. J. Cullen, J. Smith, J. V. Parry, D. DeAngelis and F. Ncube (2016). "Risk of HIV and hepatitis B and C over time among men who inject image and performance enhancing drugs in England and Wales: Results from cross-sectional prevalence surveys, 1992-2013." Jaids-Journal of Acquired Immune Deficiency Syndromes **71**(3): 331-337.
Hope, V. D., J. McVeigh, A. Marongiu, M. Evans-Brown, J. Smith, A. Kimergard, S. Croxford, C. M. Beynon, J. V. Parry, M. A. Bellis and F. Ncube (2013). "Prevalence of, and risk factors for, HIV, hepatitis B and C infections among men who inject image and performance enhancing drugs: A cross-sectional study." BMJ Open **3**(9): e003207-e003207.
Hope, V. D., J. McVeigh, J. Smith, R. Glass, J. Njoroge, C. Tanner, J. V. Parry, F. Ncube and M. Desai (2017). "Low levels of hepatitis C diagnosis and testing uptake among people who inject image and performance enhancing drugs in England and Wales, 2012-15." Drug and Alcohol Dependence **179**: 83-86.
Ip, E. J., S. Doroudgar, B. Shah-Manek, M. J. Barnett, M. J. Tenerowicz, M. Ortanez and H. G. Pope, Jr. (2019). "The CASTRO study: Unsafe sexual behaviors and illicit drug use among gay and bisexual men who use anabolic steroids." Am J Addict.
Ip, E. J., M. A. Yadao, B. M. Shah, S. Doroudgar, P. J. Perry, M. J. Tenerowicz, L. Newsom, A. A. Mann, H. Mkrtchyan and H. G. Pope (2017). "Polypharmacy, Infectious Diseases, Sexual Behavior, and Psychophysical Health Among Anabolic Steroid-Using Homosexual and Heterosexual Gym Patrons in San Francisco's Castro District." Substance Use & Misuse **52**(7): 959-968.
Iversen, J., V. D. Hope and J. McVeigh (2016). "Access to needle and syringe programs by people who inject image and performance enhancing drugs." International Journal of Drug Policy **31**: 199-200.

Iversen, J., L. Topp, H. Wand and L. Maher (2013). "Are people who inject performance and image-enhancing drugs an increasing population of Needle and Syringe Program attendees?" Drug and Alcohol Review **32**(2): 205-207.
Kamour, A., N. George, D. Gwynnette, G. Cooper, D. Lupton, M. Eddleston, J. P. Thompson, J. A. Vale, H. K. Thanacoody, S. Hill and S. H. Thomas (2015). "Increasing frequency of severe clinical toxicity after use of 2,4-dinitrophenol in the UK: a report from the National Poisons Information Service." Emerg Med J **32**(5): 383-386.
Kanayama, G., G. H. Cohane, R. D. Weiss and H. G. Pope (2003). "Past anabolic-androgenic steroid use among men admitted for substance abuse treatment: An underrecognized problem?" Journal of Clinical Psychiatry **64**(2): 156-160.
Kanayama, G., M. J. Kaufman and H. G. Pope (2018). "Public health impact of androgens." Current Opinion in Endocrinology Diabetes and Obesity **25**(3): 218-223.
Karavolos, S., M. Reynolds, N. Panagiotopoulou, K. McEleny, M. Scally and R. Quinton (2015). "Male central hypogonadism secondary to exogenous androgens: a review of the drugs and protocols highlighted by the online community of users for prevention and/or mitigation of adverse effects." Clinical endocrinology **82**(5): 624-632.
Katz, E., P. Lazersfeld and E. Roper (2017). Personal Influence, the Part Played by People in the Flow of Mass Communications. New York, Routlesge.
Kees (2019). "User's voice: Steroids in the Bedroom: 'I felt like an overworked porn star." HED Matters **2**(2): 13-15.
Llewellyn, W. (2017). Anabolics. Jupiter, FL, Molecular Nutrition.
Mamelak, M., J. M. Escriu and O. Stokan (1977). "Effects of Gamma-Hydroxybutyrate on Sleep." Biological Psychiatry **12**(2): 273-288.
McCambridge, J., L. Mitcheson, A. Winstock and N. Hunt (2005). "Five-year trends in patterns of drug use among people who use stimulants in dance contexts in the United Kingdom." Addiction **100**(8): 1140-1149.
McVeigh, J. (2019). "Engaging with people who use image and performance enhancing drugs: One size does not fit all." International Journal of Drug Policy **71**: 1-2.
McVeigh, J., J. Germain and M. C. Van Hout (2017). "2,4-Dinitrophenol, the inferno drug: a netnographic study of user experiences in the quest for leanness." Journal of Substance Use **22**(2): 131-138.
McVeigh, J., A. Kimergard, G. Bates and V. Hope (2016). "Harm reduction interventions should encompass people who inject image and performance enhancing drugs." BMJ.
Mitchell, J. A. and D. Bishop-Bailey (2019). "PPAR beta/delta a potential target in pulmonary hypertension blighted by cancer risk." Pulmonary Circulation **9**(1).
Mochizuki, R. M. and K. J. Richter (1988). "Cardiomyopathy and Cerebrovascular Accident Associated With Anabolic-Androgenic Steroid Use." Phys Sportsmed **16**(11): 109-114.
Montisci, M., R. El Mazloum, G. Cecchetto, C. Terranova, S. D. Ferrara, G. Thiene and C. Basso (2012). "Anabolic androgenic steroids abuse and cardiac death in athletes: morphological and toxicological findings in four fatal cases." Forensic Sci Int **217**(1-3): e13-18.
Narayanan, R., S. Ponnusamy, M. Fan, C. H. Yang, B. L. Grimes, M. D. Fleming, E. F. Pritchard, M. P. Berry, R. M. Oswaks, R. E. Fine, J. C. Loiseau, L. S. Schwartzberg and L. M. Pfeffer (2017). "Nonsteroidal, tissue selective androgen receptor modulator (SARM), enobosarm, reduces growth of androgen receptor-positive breast cancer in patient-derived preclinical models." Cancer Research **77**.
Nelson, M. E., S. M. Bryant and S. E. Aks (2013). ""Melanotan II injection resulting in systemic toxicity and rhabdomyolysis" Response." Clinical Toxicology **51**(4): 384-384.
Nemeth, Z., B. Kun and Z. Demetrovics (2010). "The involvement of gamma-hydroxybutyrate in reported sexual assaults: a systematic review." J Psychopharmacol **24**(9): 1281-1287.
Olszewski, D. (2008). Sexual assaults facilitated by drugs and alcohol. Lisbon, European Monitoring Centre for Drugs and Drug Addiction.

Paurobally, D., F. Jason, B. Dezfoulian and A. F. Nikkels (2011). "Melanotan-associated melanoma." Br J Dermatol **164**(6): 1403-1405.
Pereira, E., S. J. Moyses, S. A. Ignacio, D. K. Mendes, D. S. da Silva, E. Carneiro, A. Hardy, E. A. R. Rosa, P. V. C. Bettega and A. Johann (2019). "Anabolic steroids among resistance training practitioners." PLoS One **14**(10): e0223384.
Perkins, R. G. (1919). "A STUDY OF THE MUNITIONS INTOXICATIONS IN

FRANCE." PUBLIC HEALTH REPORTS **84**(43): 2335-2374.
Perry, P. J., W. R. Yates and K. H. Andersen (1990). "Psychiatric Symptoms Associated with Anabolic Steroids: A Controlled, Retrospective Study." ANNALS OF CLINICAL PSYCHIATRY **2**: 11-17.
Peters, B., H. Hadimeri, R. Wahlberg and H. Afghahi (2020). "Melanotan II: a possible cause of renal infarction: review of the literature and case report." Cen Case Reports **9**(2): 159-161.
Petroczi, A., J. A. V. Ocampo, I. Shah, C. Jenkinson, R. New, R. A. James, G. Taylor and D. P. Naughton (2015). "Russian roulette with unlicensed fat-burner drug 2,4-dinitrophenol (DNP): evidence from a multidisciplinary study of the internet, bodybuilding supplements and DNP users." Substance Abuse Treatment Prevention and Policy **10**.
Phillips, W. N. (1991). Anabolic reference guide. Golden, CO, U.S.A., Mile High Pub.
Pope, H. G., Jr., G. Kanayama, A. Athey, E. Ryan, J. I. Hudson and A. Baggish (2014). "The lifetime prevalence of anabolic-androgenic steroid use and dependence in Americans: current best estimates." Am J Addict **23**(4): 371-377.
Pope, H. G. and D. L. Katz (1992). "Psychiatric Effects of Anabolic-Steroids." Psychiatric Annals **22**(1): 24-29.
Pope, H. G., R. I. Wood, A. Rogol, F. Nyberg, L. Bowers and S. Bhasin (2014). "Adverse Health Consequences of Performance-Enhancing Drugs: An Endocrine Society Scientific Statement." Endocrine Reviews **35**(3): 341-375.
Rahnema, C. D., L. I. Lipshultz, L. E. Crosnoe, J. R. Kovac and E. D. Kim (2014). "Anabolic steroid-induced hypogonadism: diagnosis and treatment." Fertility and Sterility **101**(5): 1271-1279.
Rogers, E. M. (1983). Diffusion of innovations. New York, The Free Press.
Rogers, E. M. (1995). Diffusion of drug abuse prevention programs: spontaneous diffusion, agenda setting, and reinvention. Reviewing the behavioral science knowledge base on technology transfer. T. E. Backer, S. L. David and G. P. Soucy. Rockville, MD, United States Government Printing. **155:** 90-105.
Rowe, R., I. Berger, B. Yaseen and J. Copeland (2017). "Risk and blood-borne virus testing among men who inject image and performance enhancing drugs, Sydney, Australia." Drug and Alcohol Review **36**(5): 658-666.
Sagoe, D., J. McVeigh, A. Bjornebekk, M. S. Essilfie, C. S. Andreassen and S. Pallesen (2015). "Polypharmacy among anabolic-androgenic steroid users: a descriptive metasynthesis." SUBSTANCE ABUSE TREATMENT PREVENTION AND POLICY **10**(ARTN 12).
Sagoe, D., H. Molde, C. S. Andreassen, T. Torsheim and S. Pallesen (2014). "The global epidemiology of anabolic-androgenic steroid use: a meta-analysis and meta-regression analysis." Annals of Epidemiology **24**(5): 383-398.
Sagoe, D. and S. Pallesen (2018). "Androgen abuse epidemiology." Curr Opin Endocrinol Diabetes Obes **25**(3): 185-194.
Salinas, M., W. Floodgate and R. Ralphs (2019). "Polydrug use and polydrug markets amongst image and performance enhancing drug users: Implications for harm reduction interventions and drug policy." Int J Drug Policy **67**: 43-51.
Saud, A. (2020). "What is GHB, the liquid ecstasy drug implicated in Reynhard Sinaga's crimes?" The Conversation.
Sculthorpe, N., F. Grace, P. Jones and B. Davies (2010). "Evidence of altered cardiac electrophysiology following prolonged androgenic anabolic steroid use." Cardiovasc Toxicol **10**(4): 239-243.

Street, C. and M. C. Scally (2000). "Pharmaceutical intervention of anabolic steroid induced hypogonadism - our success at restoration of the HPG axis." Medicine & Science in Sports & Exercise **32**(5S).
Su, T. P., M. Pagliaro, P. J. Schmidt, D. Pickar, O. Wolkowitz and D. R. Rubinow (1993). "Neuropsychiatric Effects of Anabolic-Steroids in Male Normal Volunteers." Jama-Journal of the American Medical Association **269**(21): 2760-2764.
Sumnall, H. R., M. Evans-Brown and J. McVeigh (2011). "Social, policy, and public health perspectives on new psychoactive substances." Drug Test Anal **3**(7-8): 515-523.
Tan, R. S. and D. Vasudevan (2003). "Use of clomiphene citrate to reverse premature andropause secondary to steroid abuse." Fertility and Sterility **79**(1): 203-205.
Underwood, M. (2017). "Exploring the social lives of image and performance enhancing drugs: An online ethnography of the Zyzz fandom of recreational bodybuilders." International Journal of Drug Policy **39**: 78-85.
Underwood, M. (2019). "The unintended consequences of the current approach to blood borne virus prevention amongst people who inject image and performance enhancing drugs: A commentary based on enhanced bodybuilder perspectives." The International Journal of Drug Policy **67**: 19-23.
Underwood, M. and R. Olson (2018). "'Manly tears exploded from my eyes, lets feel together brahs': Emotion and masculinity within an online body building community." Journal of Sociology.
Van Beek, I. a. C., K. (2015). "Performance and image enhancing drug injectors' access to needle syringe programes: Responding to a public policy dilemma." International Journal of Drug Policy **26**: 868-874.
Van Hout, M. C. and J. McVeigh (2019). The use of sunless synthetic tanning products. Human enhancement drugs. K. Van de Ven, K. Mulrooney and J. McVeigh. Abingdon, Oxon, Routledge.
Westlye, L. T., T. Kaufmann, D. Alnaes, I. R. Hullstein and A. Bjornebekk (2017). "Brain connectivity aberrations in anabolic-androgenic steroid users." Neuroimage Clin **13**: 62-69.
Wish, E. D., A. S. Billing, E. E. Artigiani and T. Hippolyte (2020). Drug Early Warning Signals (DEWS): Central Receiving Facility (CRF) at Gracepoint - Hillsborough County, Florida. Washington, DC, National Drug Control Policy. :.
Zahnow, R., J. McVeigh, G. Bates, V. Hope, J. Kean, J. Campbell and J. Smith (2018). "Identifying a typology of men who use Anabolic Androgenic Steroids (AAS)." The International Journal of Drug Policy **55**: 105-112.
Zahnow, R., J. McVeigh, J. Ferris and A. Winstock (2017). "Adverse Effects, Health Service Engagement, and Service Satisfaction Among Anabolic Androgenic Steroid Users." Contemporary Drug Problems **44**(1): 69-83.